WHAT IS CLAIMED IS:

1. A thermoionic cathode, comprising:

a substrate;

an emissive layer; and

a buffer, located between said substrate and said emissive layer, said buffer modifying a grain structure at a surface of said substrate contacting said buffer.

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2. The thermoionic cathode of claim 1, said buffer further randomizing a crystallographic orientation of the grain structure at a surface of said substrate contacting said buffer.

3. The thermoionic cathode of claim 1, said buffer further miniaturizing grain sizes of grains at the surface of said substrate contacting said buffer.

4. The thermoionic cathode of claim 3, wherein the grain sizes of the grains at the surface of said substrate are less than 4 μm.

5. The thermoionic cathode of claim 1, wherein said buffer modifies the grain structure at the surface of said substrate contacting said buffer by one of altering and blocking.

6. The thermoionic cathode of claim 5, said buffer altering the grain structure at the surface of said substrate contacting said buffer by at least one of dissolution, alloying, reaction, precipitation, and new phase formation.

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7. The thermoionic cathode of claim 1, wherein said buffer is from a chemical class similar to a chemical class of said substrate.

8. The thermoionic cathode of claim 7, wherein said buffer and said substrate are both refractory metals or carbon.

9. The thermoionic cathode of claim 1, wherein said cathode has a curved shape.

10. The thermoionic cathode of claim 6, wherein said buffer is a solid solution buffer.

11. The thermoionic cathode of claim 10, wherein said buffer includes at least two of the group consisting of Mo, W, Nb, V, Ir, Rh, and Ta.

12. The thermoionic cathode of claim 11, wherein the solid solution buffer includes molybdenum, tungsten and tantalum.

13. The thermoionic cathode of claim 12, wherein said substrate and said emissive layer are made of tantalum.

14. The thermoionic cathode of claim 1, wherein said cathode is part of a projection electron lithography system.

15. The thermoionic cathode of claim 14, wherein the projection electron lithography system is a SCALPEL™ system.

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16. The thermoionic cathode of claim 5, said buffer blocking the grain structure at the surface of said substrate contacting said buffer by at least one of alloying, reaction, precipitation, and new phase formation.

Sub C1

17. The thermoionic cathode of claim 16, wherein said buffer is an alloyed buffer.

18. The thermoionic cathode of claim 17, wherein said buffer is an alloy comprising at least two elements with different crystalline structure.

19. The thermoionic cathode of claim 17, wherein said buffer is made of a grain growth inhibiting multiphase structure.

Sub C2

20. The thermoionic cathode of claim 16, wherein said buffer includes at least two of Re, Ta, C, Hf, Tc, Os, and Ru.

21. The thermoionic cathode of claim 20, wherein the buffer includes rhenium and tantalum.

22. The thermoionic cathode of claim 21, wherein said substrate and said emissive layer are made of tantalum.

23. A method of making a thermoionic cathode, comprising:

preparing a surface of a substrate;

depositing a buffer on the substrate, wherein the buffer modifies a grain structure at the surface of the substrate contacting the buffer;

depositing an emissive layer on the buffer.

24. The method of making the thermoionic cathode of claim 23, said step of preparing the surface of the substrate including the steps of,

ion etching and vacuum annealing the surface of the substrate.

25. The method of making the thermoionic cathode of claim 23, wherein the buffer is deposited by sputtering.

26. The method of making the thermoionic cathode of claim 23, wherein the emissive layer is deposited by sputtering.

27. The method of making the thermoionic cathode of claim 23, further comprising:

vacuum annealing the buffer, after deposition of the buffer; and

vacuum annealing the emissive layer, after deposition of the emissive layer.

28. The method of claim 23, said buffer further randomizing a crystallographic orientation of the grain structure at the surface of the substrate contacting the buffer.

29. The method of claim 23, said buffer further miniaturizing grain sizes of grains at the surface of said substrate contacting said buffer.

30. The method of claim 29, wherein the grain sizes of the grains at the surface of said substrate are less than 4 μm.

31. The method of claim 23, wherein said buffer modifies the grain structure at the surface of said substrate contacting said buffer by one of altering and blocking.

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32. The method of claim 31, wherein the buffer alters the grain structure at the surface of the substrate contacting the buffer by at least one of diffusion, alloying, reaction, precipitation, and new phase formation.

33. The method of claim 32, wherein the buffer is deposited by co-sputtering Ta and at least one of Re, C, Hf, Os, and Ru on the substrate.

34. The method of claim 31, said buffer blocking the grain structure at the surface of said substrate contacting said buffer by at least one of alloying, reaction, precipitation, and new phase formation.

35. The method of claim 33, wherein the buffer is deposited by sputtering at least one of Re, C, Hf, Os, and Ru on the substrate.